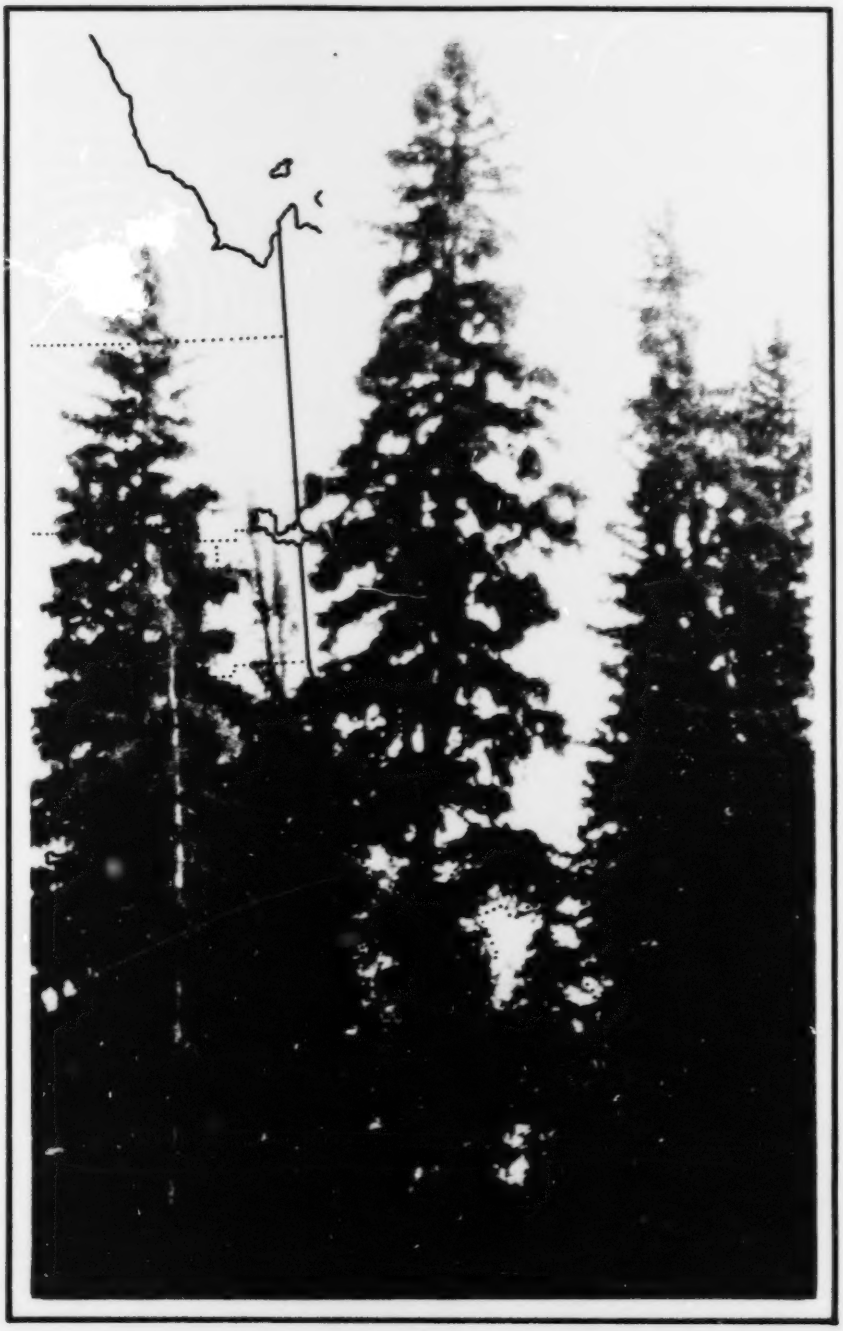
Forest Research Report No. 109

# Identification of Remnant White Spruce in Southern Ontario: A Basis for Gene Conservation



Ontario Ministry of Natural Resources

Hon. Alan W. Pope
Minister

John R. Sloan
Deputy Minister

85-3320/

Forest Research Report No. 109

# Identification of Remnant White Spruce in Southern Ontario: A Basis for Gene Conservation

W. vanBorrendam

Additional copies of this publication
may be obtained from:
Ontario Tree Improvement and
Forest Biomass Institute
Ministry of Natural Resources
Maple, Ontario L0J 1E0
(416) 832-2761

© 1984 Government of Ontario

Ontario Ministry of Natural Resources

Hon. Alan W. Pope
Minister

John R. Sloan
Deputy Minister

VANBORRENDAM, W. 1984. Identification of remnant white spruce in Southern Ontario: a basis for gene conservation. Ont. Min. Natur. Resour., Forest Res. Rep. 109. 20 p.

## ABSTRACT

The methodology to survey natural remnants of white spruce stands (Picea glauca (Moench) Voss) in southern Ontario is described. The distribution of stands suggests fourteen major groups (potential populations) from which seed or scion material should be collected to conserve the gene pool. Maps of Ontario Ministry of Natural Resources forest districts indicate where white spruce stands can be found. Recommendations to conserve the white spruce gene pools are discussed.

## INTRODUCTION

The potential value of southern Ontario white spruce (Picea glauca (Moench) Voss) genetic material has been indicated by Teich et al. (1975) based on 15- and 20-year-old provenance trials. Previously two sources, Beachburg and Peterborough, were identified in the Lake States and eastern Canada trials (Nienstaedt and Teich 1972), and the possibility of a broadly located superior population was suggested. Potential growth advantages of up to 40 percent in mean height were associated with selection of seed source.

After many decades of land development and forest exploitation across southern Ontario, only remnant stands and scattered groups of white spruce remain. The gene resources of the species have undoubtedly been depreciated. Since foresters generally deal with highly heterogeneous wild populations, a primary concern is to avoid such widespread loss or depreciation of gene pools rather than just of specific genes or genotypes (Yeatman 1971).

A gene pool conservation program was initiated in May 1980, to identify the remaining white spruce in southern Ontario. To accomplish this, a survey was undertaken to locate and catalogue residual white spruce. The results of the survey form a basis for:

1) investigating the genetic structure of the remnant population of white spruce;
2) a program of gene conservation; and
3) an evaluation of the potential of residual sources for use in regeneration and breeding programs.

## METHODOLOGY

The administrative regions and districts of the Ontario Ministry of Natural Resources across southern Ontario were used as a framework for the survey. Since each district is subdivided into townships, these were used as the basic working units to systematically cover the territory where white spruce should be conserved. Stands were located on 1:50 000 maps (National Topographic Systems Maps of Canada, Energy, Mines and Resources, Canada). Two invaluable attributes of these maps were the delineation of forested and agricultural lands and the demarkation of marshes and wet areas, where most of the remaining white spruce occur.

An extensive, well spaced road system in all but a few townships enabled complete visual ground coverage of most areas. Where road coverage was inadequate, aerial survey provided a secondary alternative. After the ground surveys were completed, selected areas in each district were rechecked from the air and more accurate boundaries of large white spruce stands established. These aerial surveys were conducted after leaf fall, allowing better identification of conifers in each stand. Aerial checking was not carried out in the Eastern Region for lack of resources.

Stands with a minimum of 20 white spruce trees, or groups of trees thus identified, were recorded on the topographic maps. An example of one of these maps is shown in Figure 1. On the original maps, the stands were marked in yellow. For each district, a set of these topographic maps and a summary map of the whole district (scale 1:250000) were

FIGURE 1 Example of part of a township map indicating white spruce stand locations. This particular map corresponds to Table 1.

TABLE 1. Example of catalogued information attached to each township map.

ERIN TOWNSHIP

| Stand Number | # Trees | Size | Distribution | Cones 1980 | Notes |
|---|---|---|---|---|---|
| 72-006840-I-25-1 | 100+ | small, med, large | widely scattered | no | |
| 72-006840-II-17-2 | 60+ | small, med | widely scattered | no | |
| 72-006840-II-6-3 | 100+ | med, large | scattered | some | some good trees |
| 72-006840-III-21-4 | 50+ | med, large | scattered | no | |
| 72-006840-II-27-5 | 20+ | med | scattered | no | |
| 72-006840-III-32-6 | 30+ | small, med | widely scattered | no | |
| 72-006840-IV-32-7 | 35+ | small, med | scattered | no | |
| 72-006840-IV-23-8 | 20+ | small, med | widely scattered | no | |
| 72-006840-IV-17-9 | 100+ | small, med, large | scattered | some | along river |
| 72-006840-IV-12-10 | 35+ | small, med | widdly scattered | no | |
| 72-006840-V-23-11 | 25+ | med | widely scattered | no | |
| 72-006840-VI-18-12 | 60+ | med, large | close spacing | no | |
| 72-006840-VIII-18-13 | 100+ | small, med, large | scattered | no | |
| 72-006840-IX-26-14 | 50+ | small, med large | scattered | no | |
| 72-006840-XI-14-15 | 50+ | med, large | scattered | no | |
| 72-006840-IX-21-16 | 25+ | med, large | scattered | no | |
| 72-006840-X-21-17 | 35+ | med, large | scattered | no | |
| 72-006840-XI-16-18 | 30+ | med, large | scattered | no | |
| 72-006840-XI-18-19 | 35+ | med, large | scattered | no | |
| 72-006840-XI-28-20 | 100+ | med, large | widely scattered | some | |

collected into an atlas. Each township map was accompanied by a catalogue of all identified white spruce stands. Each stand was described in terms of estimated number, height, quality and distribution of white spruce trees. An example of a map catalogue corresponding to Figure 1 is shown in Table 1.

File reports were prepared for the Pembroke District[1] of the Algonquin Region and for the Central[2], Southwestern[3] and Eastern[4] Regions. These reports included a colour photograph of the summary map of the specific region, colour photographs of each of the summary district maps, the methodology used in the survey and recommendations to conserve the white spruce gene pool. The atlas is found as the appendix of the report. Each respective district received colour reproductions of the atlas while each region received colour reproductions of the respective district atlases. These region and district atlases and the original set of atlases, kept at the Ontario Tree Improvement and Forest Biomass Institute, Maple, Ontario, are the only ones in existence. In addition, a progress report was published after completion of work in the Central Region (vanBorrendam and Skeates 1982).

## OBSERVATIONS AND CONCLUSIONS

Observations from the roadside and air are effective survey techniques for large areas. Since white spruce normally occurs as a scattered component among other species, aerial photography and forest resource inventory data provided only minimal help in locating stands or scattered trees. The systematic survey enabled all significant occurrences of white spruce in the area covered to be located.

The number of natural white spruce stands from which significant numbers of trees still exist is summarized in Table 2. It should be noted that there is a very high degree of variability in the stand size and in the number of white spruce trees in a stand, due to the scattered nature of the species.

In the extreme southern portions of its range, white spruce is found primarily on cool, moist site conditions. The species may have been eliminated on certain upland sites as a result of agricultural development but it is evident that conservation of the remaining white spruce genetic base will depend on residual stands and scattered trees found on moist and wet sites.

In southern Ontario, the southern boundary of the natural range of white spruce, based on the residual stands identified (Fig. 2), appears to approximate the southern boundary of site region 6E (Hills 1960). No white spruce stands were found in site region 7E, only scattered remnants were found in site region 6E while more highly concentrated white spruce stands were found in site region 5E. The higher frequencies of white

---

[1]VANBORRENDAM, W. 1981. White spruce gene pool conservation: Pembroke District. Ont. Min. Natur. Resour., Maple, Ont. 7 p.

[2]VANBORRENDAM, W. 1981. White spruce gene pool preservation: Central Region report. Ont. Min. Natur. Resour., Maple, Ont. 28 p.

[3]VANBORRENDAM, W. 1981. White spruce gene pool conservation: Southwestern Region report. Ont. Min. Natur. Resour., Maple, Ont. 20 p.

[4]VANBORRENDAM, W. 1983. White spruce gene pool conservation: Eastern Region report. Ont. Min. Natur. Resour., Maple, Ont. 26 p.

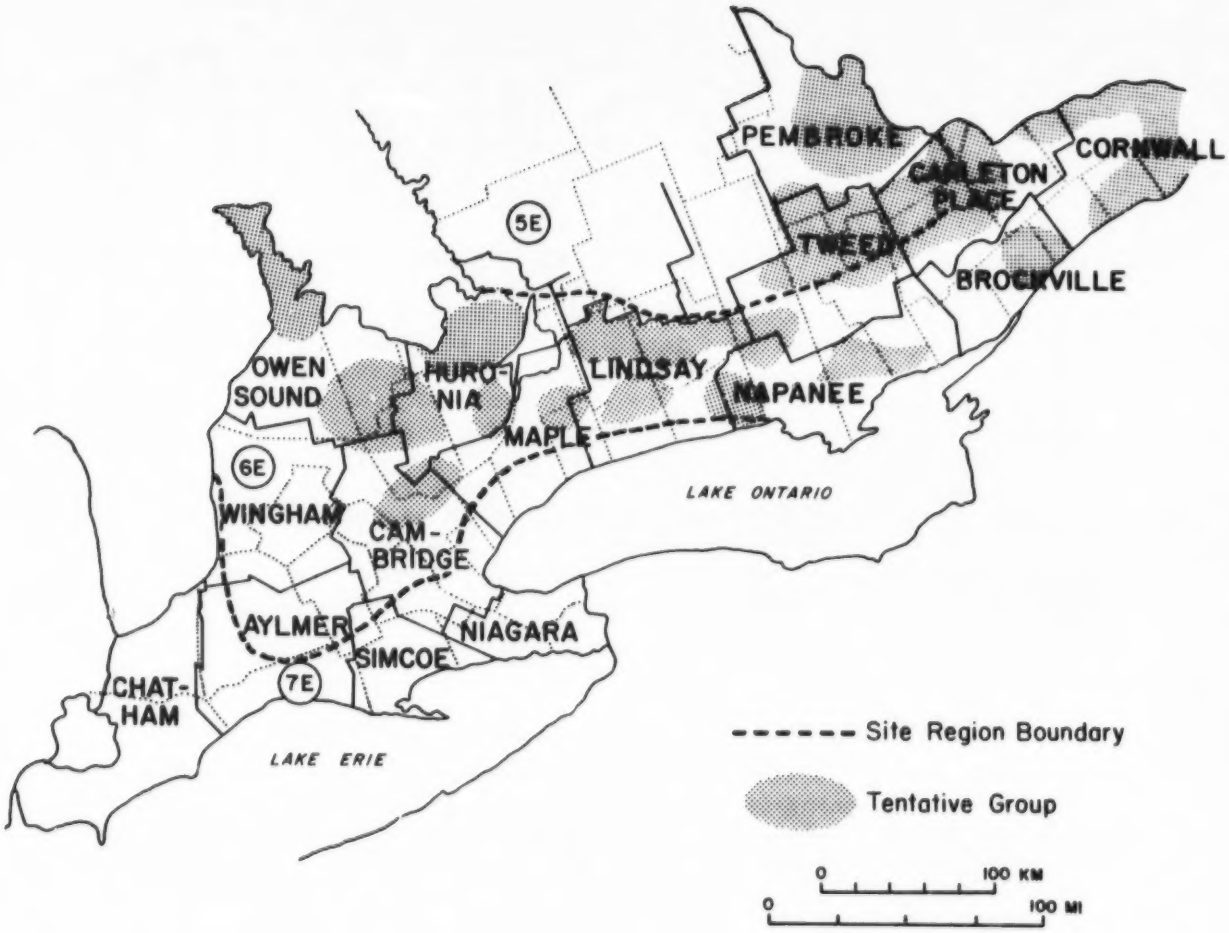



FIGURE 2 Suggested grouping of white spruce stands in southern Ontario.

spruce found in site region 5E roughly represent the southern fringe of a more continuous population of spruce found on the Precambrian Shield, which closely follows the boundary between regions 5E and 6E. Other groups of stands in site region 6E appear to be discrete occurrences.

TABLE 2 Number of white spruce stands by administrative district based on estimated number of trees per stand

| Administrative district | Number of stands | | |
|---|---|---|---|
| | Estimated number of white spruce trees per stand | | |
| | 100+ | 41-100 | 20-40 |
| Southwestern Region | | | |
| Owen Sound | 17 | 26 | 63 |
| Wingham | 0 | 0 | 1 |
| Central Region | | | |
| Cambridge | 11 | 13 | 38 |
| Maple | 9 | 13 | 29 |
| Huronia | 26 | 47 | 59 |
| Lindsay | 71 | 47 | 48 |
| Eastern Region | | | |
| Napanee | 25 | 27 | 57 |
| Brockville | 0 | 10 | 31 |
| Cornwall | 8 | 21 | 49 |
| Carleton Place | 93 | 110 | 129 |
| Tweed | 39 | 38 | 66 |
| Algonquin Region | | | |
| Pembroke | 62 | 111 | 82 |
| Total | 361 | 463 | 652 |

Appendix 1 contains generalized summary maps of each district, indicating the distribution of all the white spruce stands catalogued in the Owen Sound and Wingham Districts of the Southwestern Region; Appendix 2 contains maps for the Cambridge, Maple, Huronia and Lindsay Districts of the Central Region; Appendix 3 contains maps for the Napanee, Brockville, Cornwall, Carleton Place and Tweed Districts of the Eastern Region and Appendix 4 contains a map for the Pembroke District of the Algonquin Region.

A substantial number of stands with a white spruce component still occurs in much of southern Ontario. This genetic material can be saved for future generations. However, the numerous recently cut areas observed during the survey indicate that a concerted effort will be needed in the next few years if this goal is to be accomplished.

## RECOMMENDATIONS

Identification of existing gene resources is the first step in conserving gene pools. Recommendations for subsequent operations have been made[5], and are summarized as follows:

(1) From the inventory of white spruce stands it is evident that geographically isolated (potentially, genetically distinct) groups of white spruce exist. Fourteen tentative groups have been delineated (Fig. 2). These should be tested to determine variability within and between groups, thus leading to information on possible population differences. The most promising sources within each group must be identified based on field test results and isoenzyme analysis, to ensure that valuable gene pools are conserved as future building blocks in Ontario's regeneration program. Based on test results, the white spruce stands in southern Ontario should be regrouped into homogenous populations as a framework for silvicultural activity.

(2) Subsequent gene pool conservation should be carried out concurrently in two ways. First, clonal archives should be established using grafted stock, in different areas of southern Ontario. All groups should be represented in each clonal archive. Subsequent options are open to proceed with seed orchards, progeny testing, etc. Secondly, plantations should be established from seed collected from each group. Seed should be bulked and assigned separate seed source numbers. This seed can then be redirected into normal district silvicultural operations for those districts in which the groups occur. By keeping track of where source-identified stock is planted, conservation of the gene pool will be realized. Source-identified plantations provide a range of options for future work, i.e. seed production areas, seed collection areas, etc.

(3) The survey provides a framework for regional plus-tree selection in site regions 5E and 6E for seed orchards. Plus-tree selection can be made, regardless of stand size, from the catalogued stands.

Implementation of these recommendations will ensure the conservation of promising populations. This would be one step towards improved quality and higher productivity of southern Ontario's future forests.

## ACKNOWLEDGEMENTS

The author wishes to express his sincere thanks to D.A. Skeates (Seed Specialist - Ontario Tree Improvement and Forest Biomass Institute, Maple), the staff at the Ontario Ministry of Natural Resources regional and district offices, and Miss R.M. Rauter (Forest Resources Group - Silviculture Section) for their advice and valuable assistance in this project. Figures in this report were drafted by Mr. Casey Brendon.

---

[5]VANBORRENDAM, W. 1982. Proposal for white spruce gene pool conservation in southern Ontario - Phase II. Ont. Min. Natur. Resour., Maple, Ont. 7 p.

## REFERENCES

HILLS, G.A. 1960. Regional site research. For. Chron. 36: 401-423.

NIENSTAEDT, H. and A.H. TEICH. 1972. Genetics of white spruce. U.S.D.A., For. Serv. Res. Pap. WO-15. 24 p.

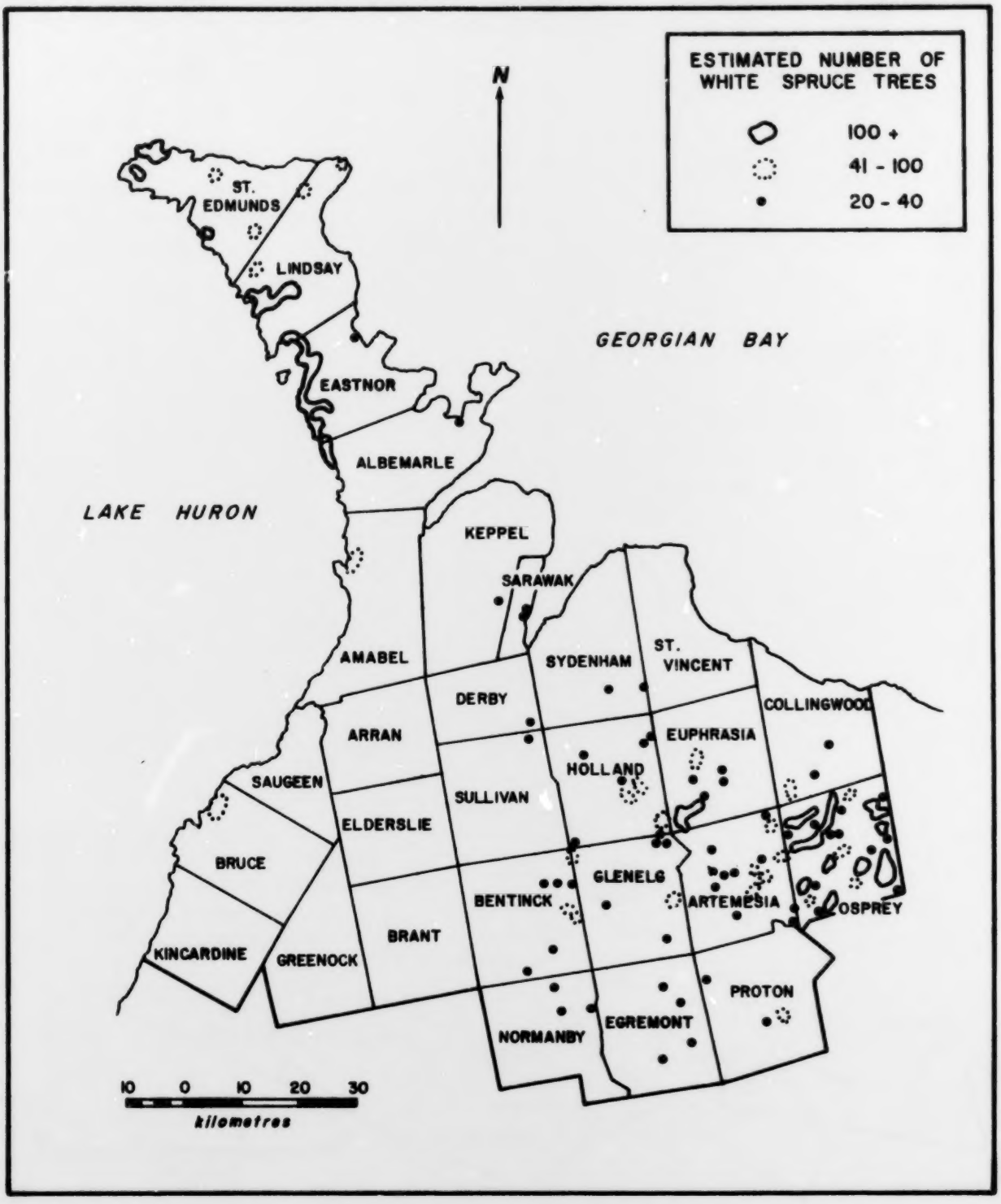
TEICH, A.H., D.A. SKEATES and E.K. MORGENSTERN. 1975. Performance of white spruce provenances in Ontario. Can. For. Serv., Petawawa For. Exp. Sta. and Ont. Min. Natur. Resour., For. Res. Br. Special Joint Report No. 1. 31 p.

VANBORRENDAM, W. and D.A. SKEATES. 1982. White spruce gene pool conservation in southern Ontario. Ont. Min. Natur. Resour., For. Res. Note 31. 4p.

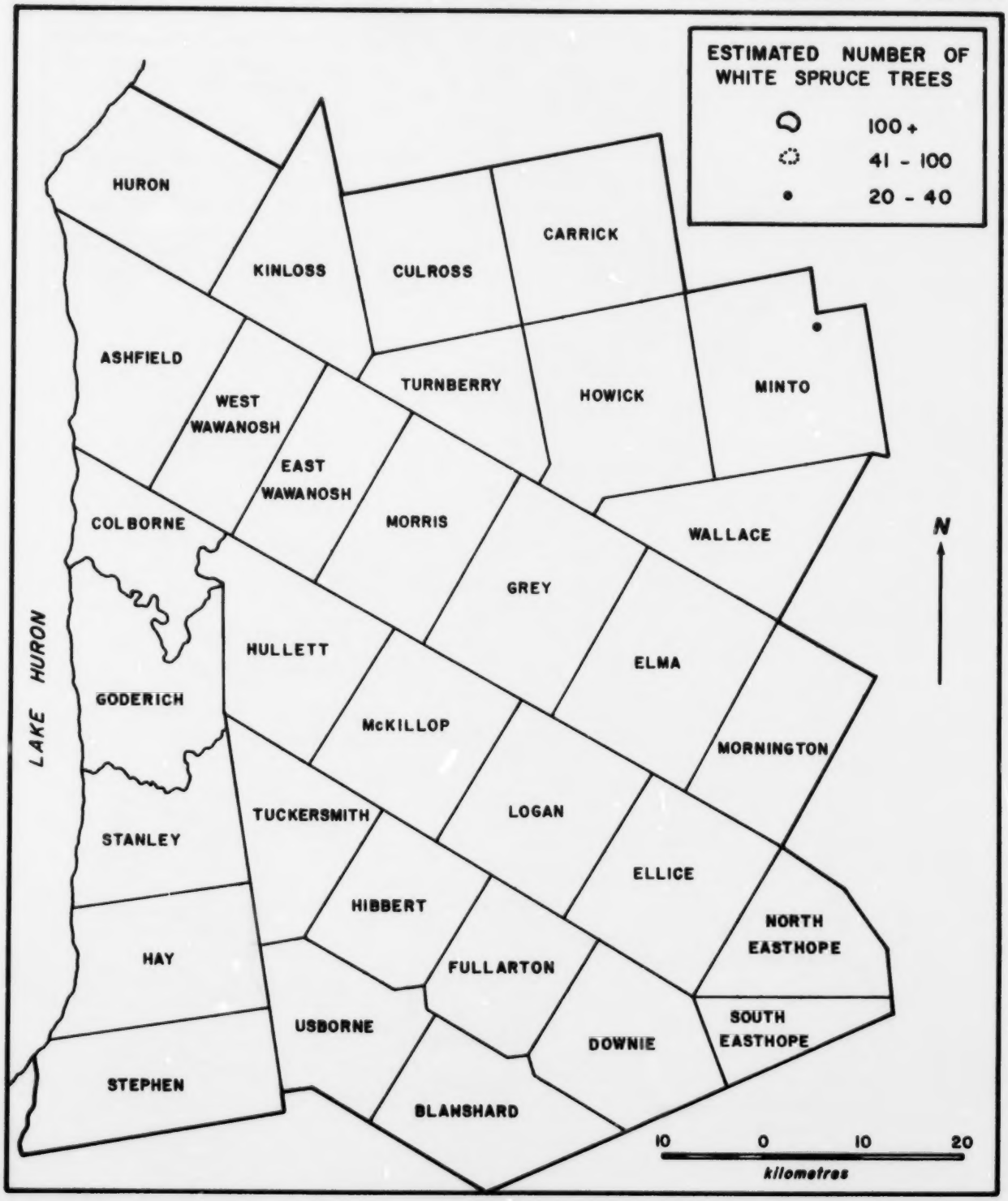
YEATMAN, C.W. 1971. Gene conservation in relation to forestry practice. In Proc. 13th Meet. Commit. For. Tree Breed., Prince George, B.C. 971. Pt. 2. p. 19-23.

# APPENDIX I

## OWEN SOUND ADMINISTRATIVE DISTRICT SOUTHWESTERN REGION

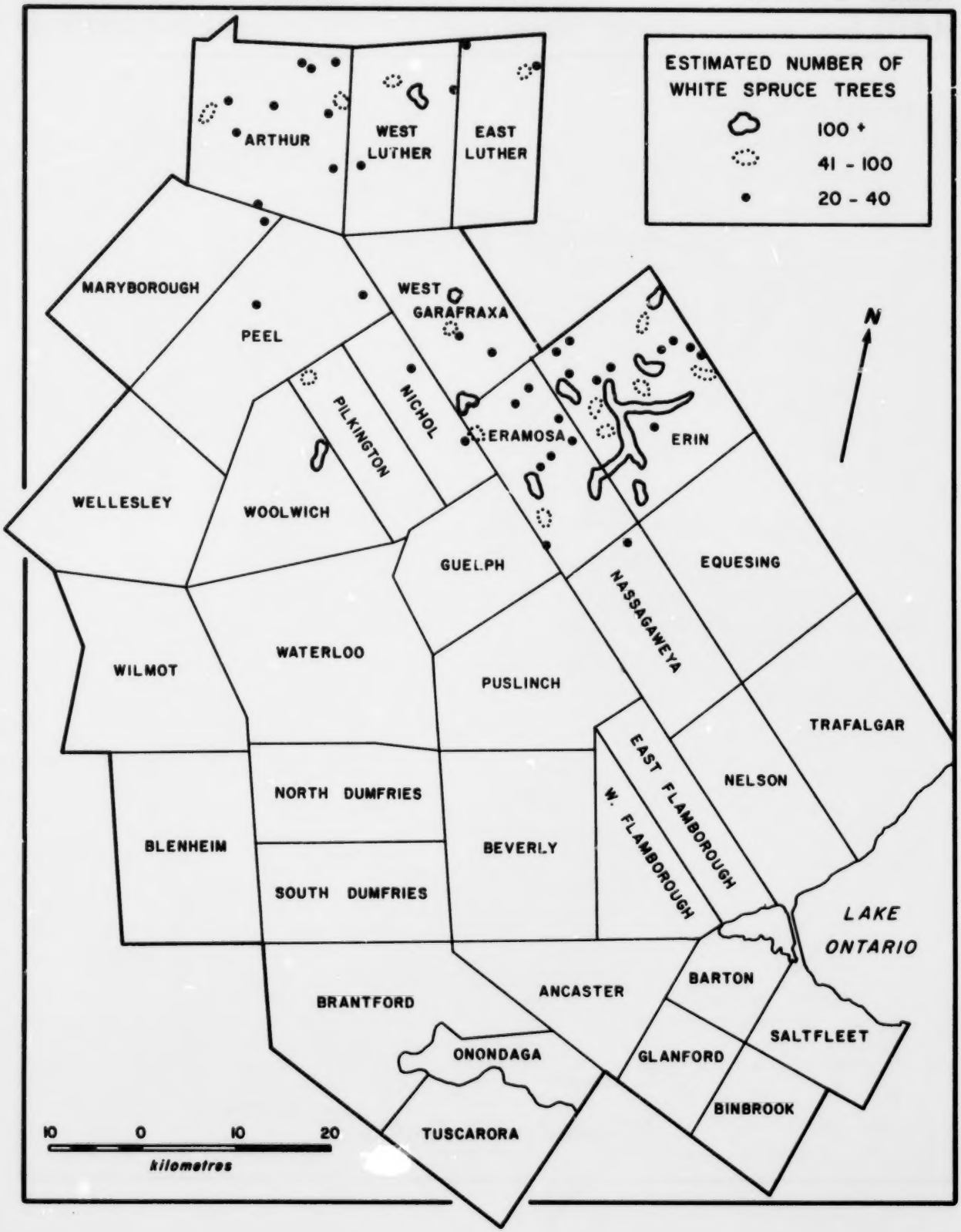


# WINGHAM ADMINISTRATIVE DISTRICT SOUTHWESTERN REGION

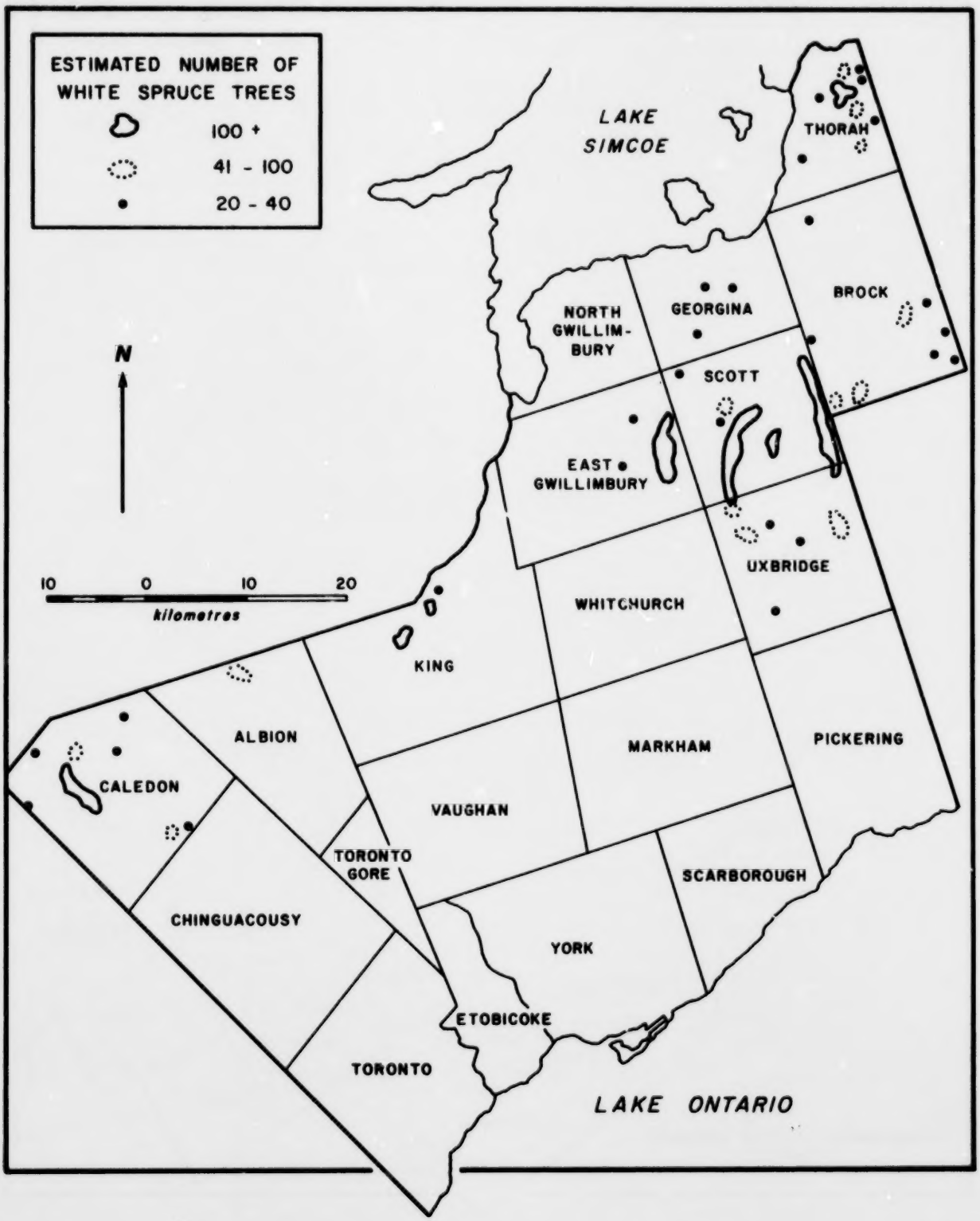


# APPENDIX 2

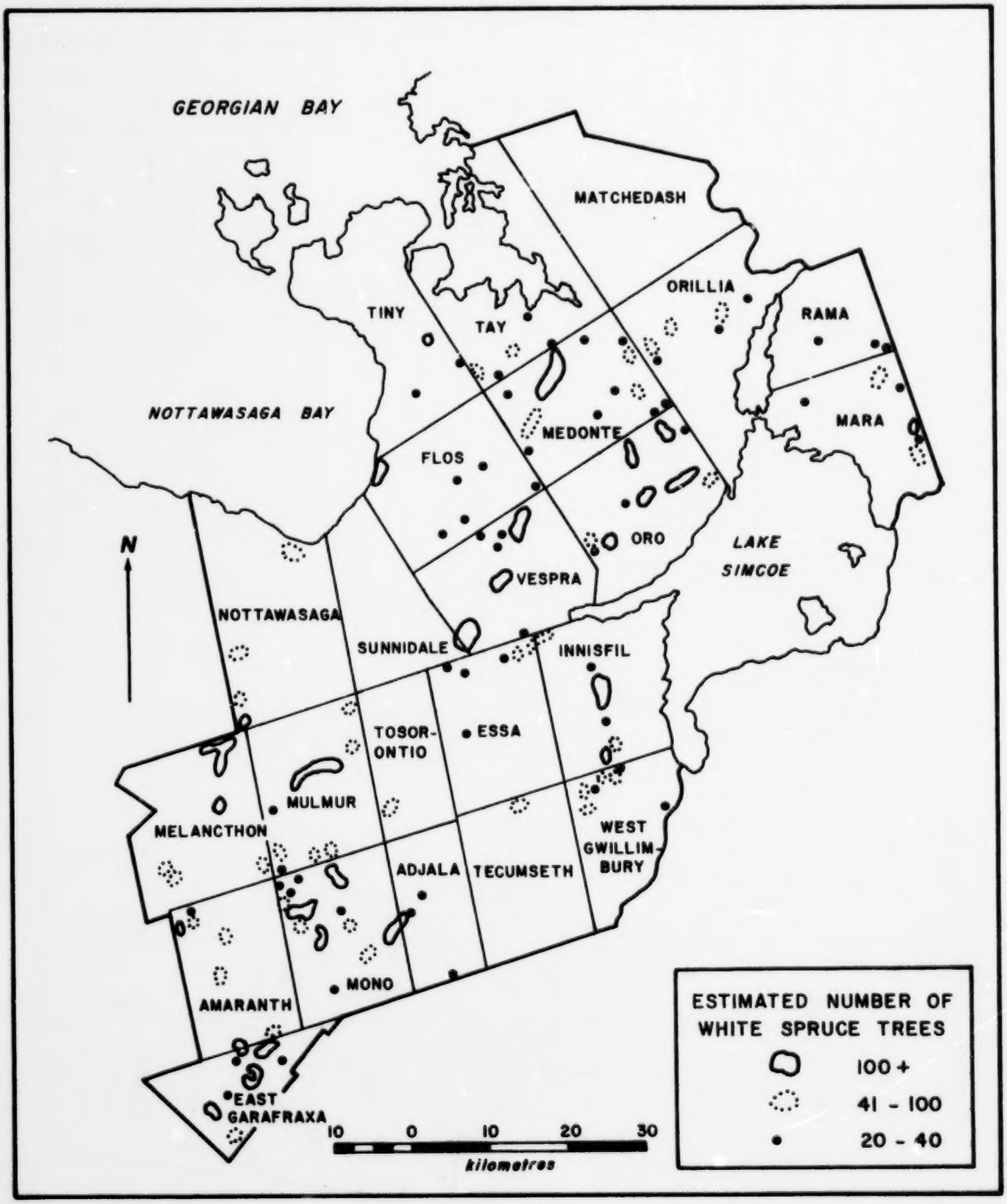
## CAMBRIDGE ADMINISTRATIVE DISTRICT — CENTRAL REGION

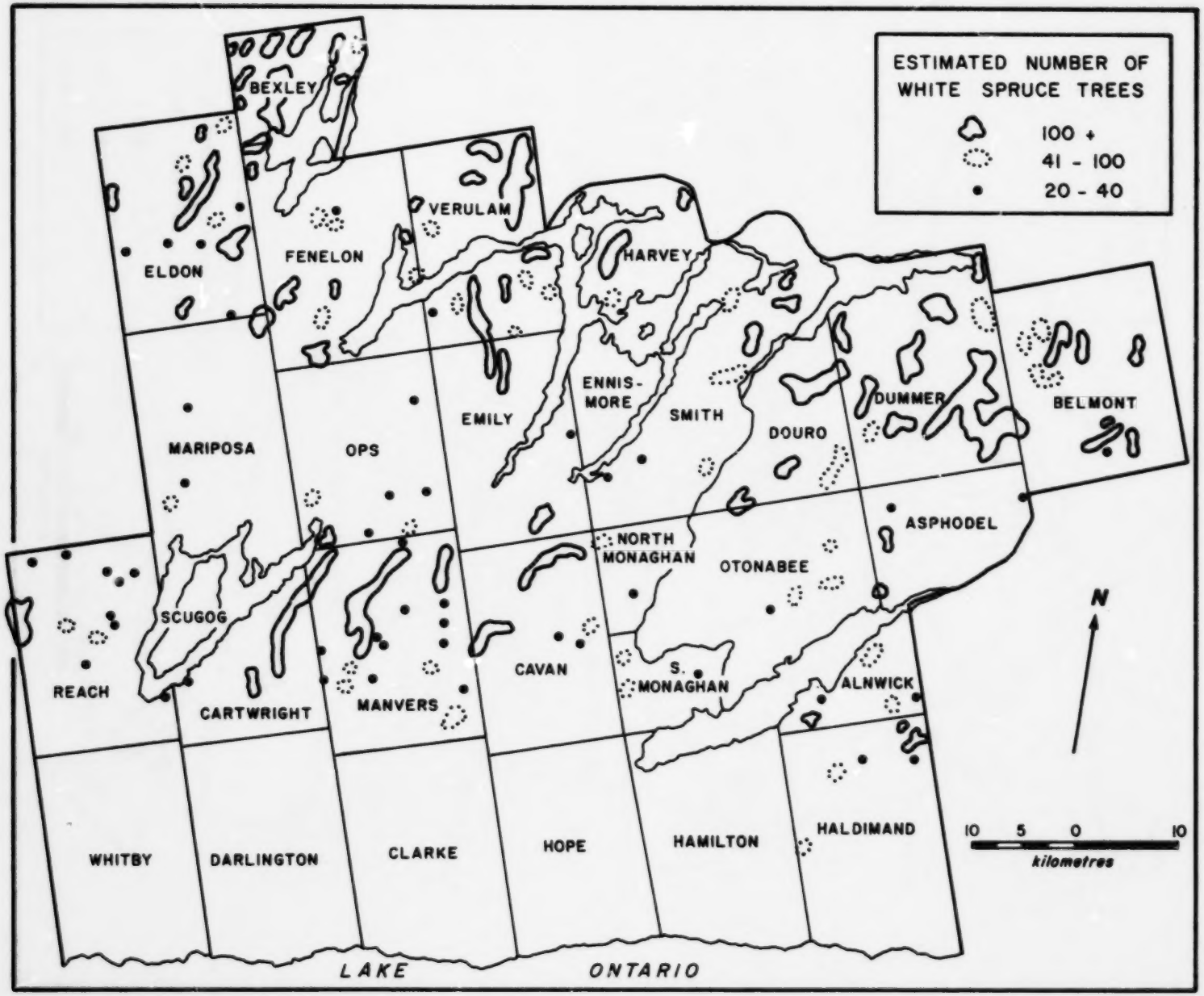


# MAPLE ADMINISTRATIVE DISTRICT — CENTRAL REGION



# HURONIA ADMINISTRATIVE DISTRICT CENTRAL REGION

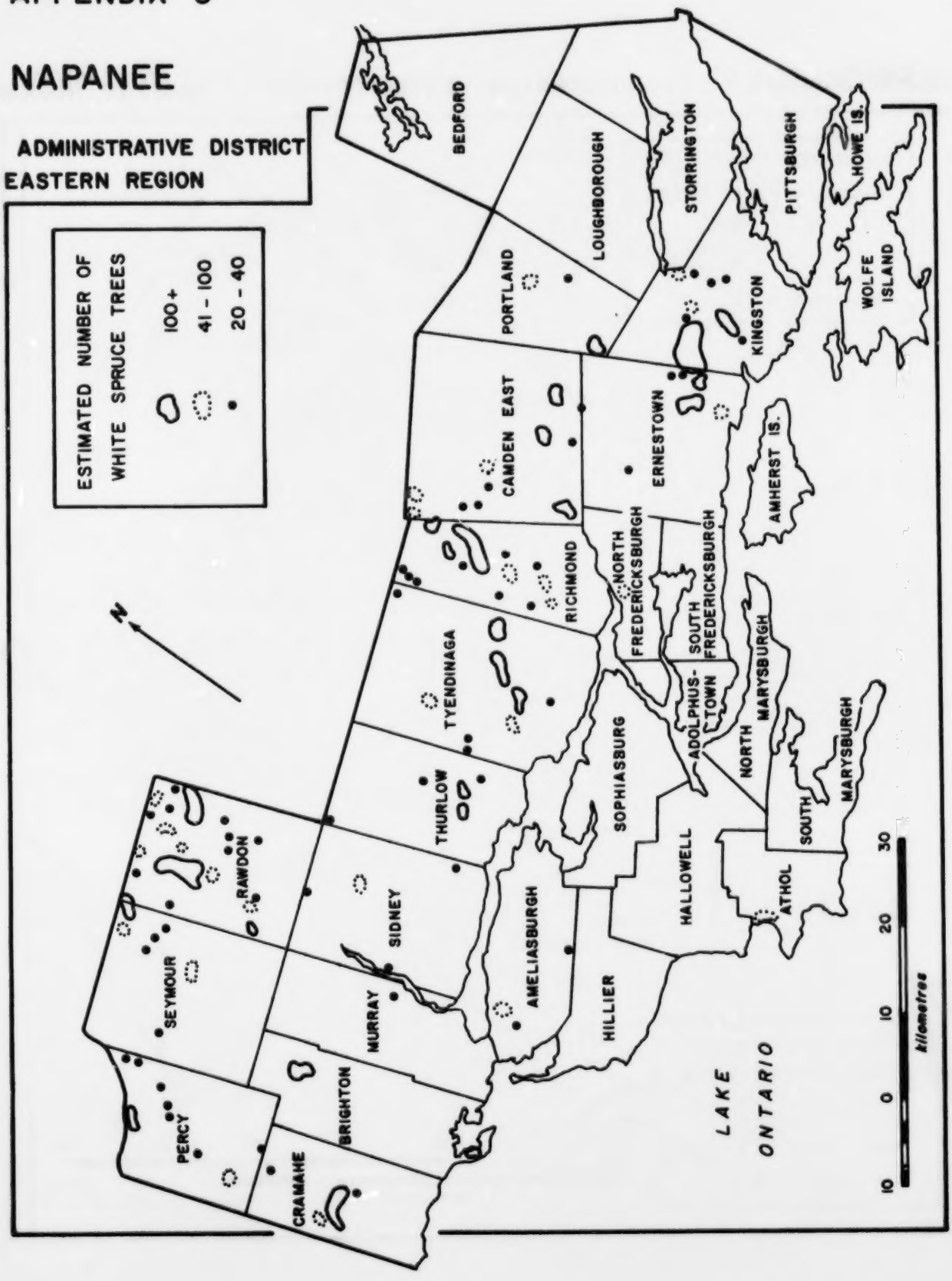




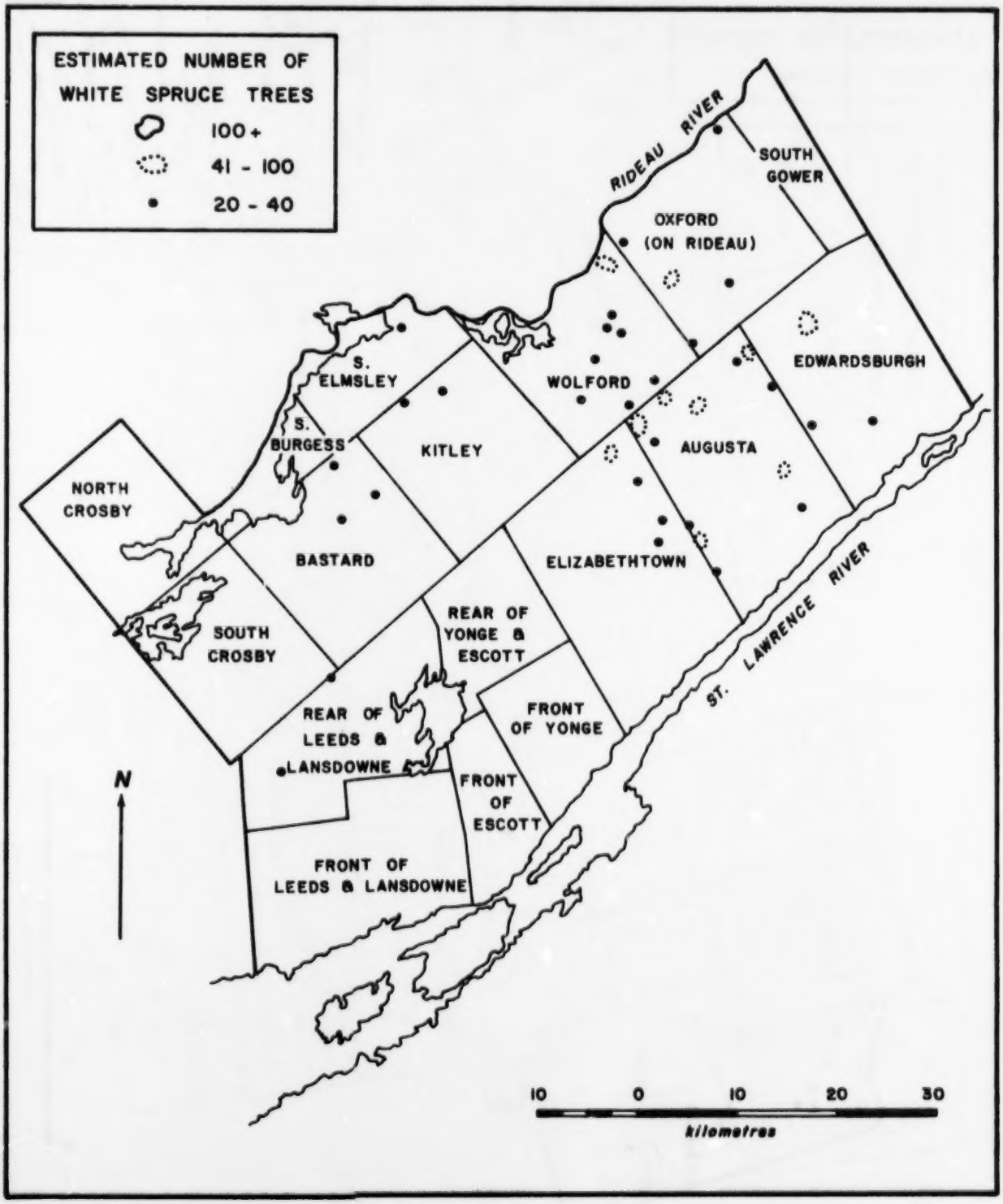

LINDSAY ADMINISTRATIVE DISTRICT CENTRAL REGION

# APPENDIX 3

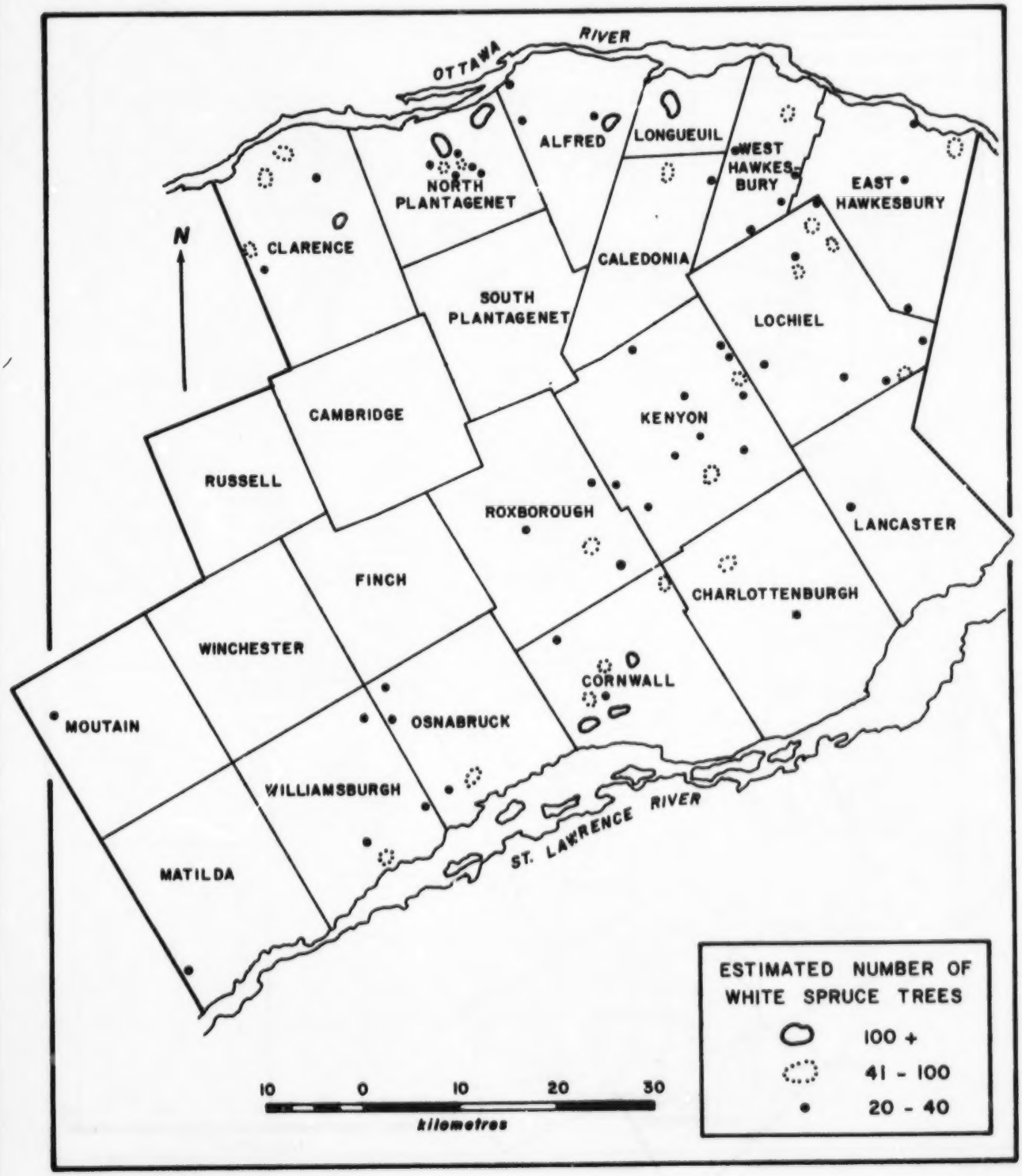
## NAPANEE



# BROCKVILLE ADMINISTRATIVE DISTRICT EASTERN REGION

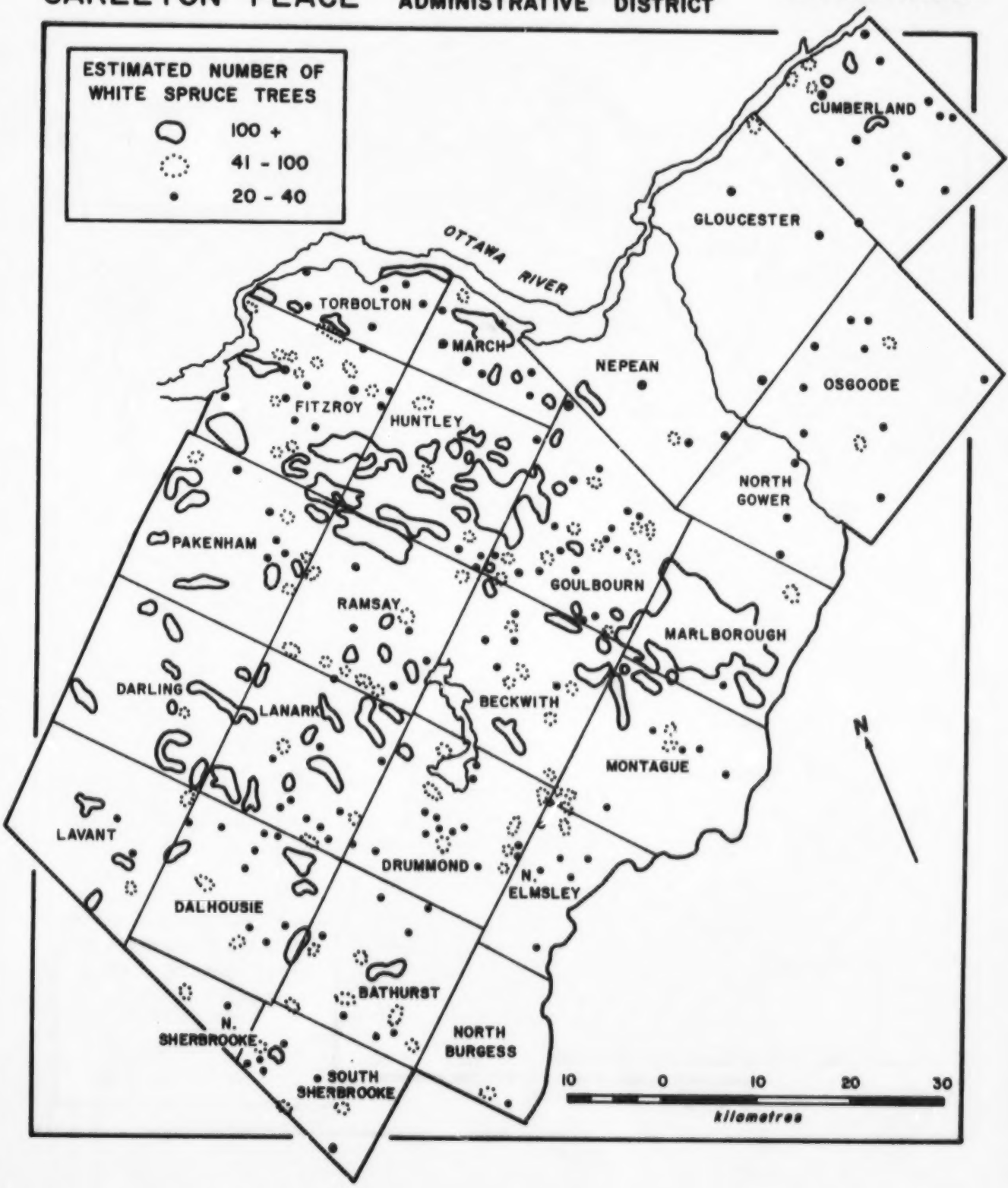


# CORNWALL ADMINISTRATIVE DISTRICT EASTERN REGION



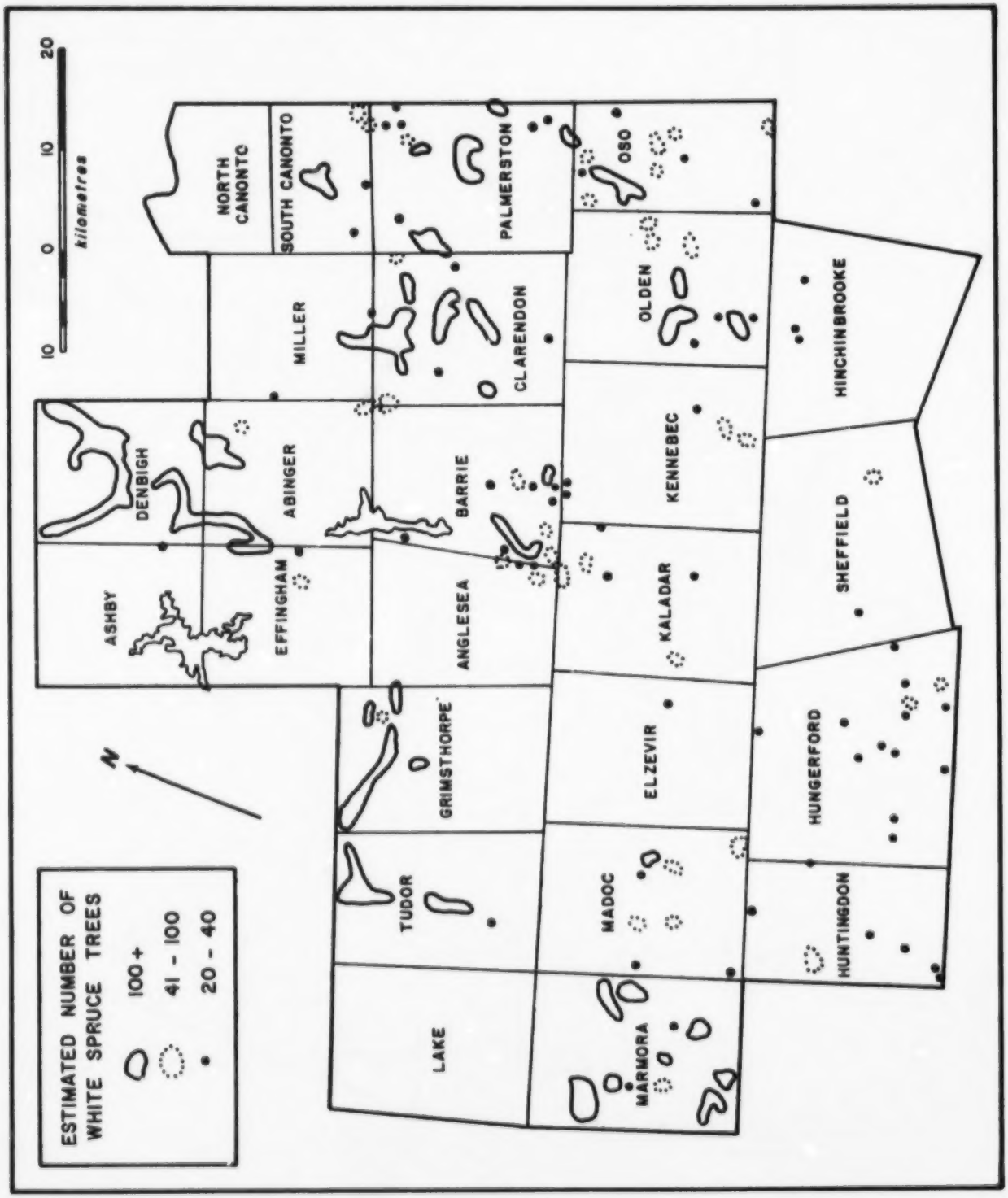
# CARLETON PLACE ADMINISTRATIVE DISTRICT

EASTERN REGION



# TWEED ADMINISTRATIVE DISTRICT

EASTERN REGION



# APPENDIX 4

## PEMBROKE ADMINISTRATIVE DISTRICT — ALGONQUIN REGION